APPLICANT(s):	Kahola		CONF. NO.:	9268
SERIAL NO.:	10/033,451		ART UNIT:	2129
FILING DATE:	03/18/2004		EXAMINER:	Omar F. Rivas Fernandas

TITLE: METHOD FOR PERFORMING LINK ADAPTATION

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APPELLANTS BRIEF

(37 C.F.R. §1.192)

This amended brief is filed in response to the Notification of Non-Compliant Appeal Brief
mailed May 10, 2007. The original Appellant's Brief was duly filed on January 5, 2007.
This is an appeal from the final rejection of the claims in the subject application. A Notice
of Appeal was filed on October 26, 2006 with a Pre-Appeal Brief Request for Review. A
Panel Decision was mailed December 5, 2006.

[1] REAL PARTY IN INTEREST

The real party in interest in this Appeal is the assignee, Nokia Corporation, Espoo, Finland.

[2] RELATED APPEAL AND INTERFERENCES

There are no related appeals or interferences.

[3] STATUS OF THE CLAIMS

Claims 2-17 stand rejected under 35USC103(a) based on the combined teaching of Agrawal, U.S. Patent No. 6,072,990, in view of the reference La Porta, U.S. Patent No. 6,654,359 , and further in view of Lewis, U.S. Patent No. 5,687,290. The rejection is contained in a first office action mailed July 5, 2006, after a Request for Continuing Examination. Claims 2-17 are presented for consideration in this Appeal and are contained in the attached Claim Appendix.

[4] STATUS OF AMENDMENTS FILED SUBSEQUENT TO FINAL REJECTION

There were no amendments filed after Final Rejection.

[5] SUMMARY OF THE CLAIMED SUBJECT MATTER

The communication system, according to independent claim 12, is shown in figure 4 of this application and described at page 7, line 8 through page 8, line 2. A communication system 1 is set up to provide communication links between terminal 2 and access points (AP) 3. To accomplish this, access point controllers (APC) 4 perform link adaptation to optimize the modulation mode for the link. The link adaptation is executed using fuzzy control in the selection of the modulation mode. Fuzzy control rules are established in which the packet error rate is used, as at least one variable, in the fuzzy logic control.

The access point controller, as described in independent claim 15, is illustrated in figure 5b and described at page 16, line 11 through page 17, line 2 of this application. As shown in figure 5b, the access point controller 4 comprises first communication equipment 9 for communication with the access point 3. The access point 3 has corresponding communication equipment 13. Additionally, the access point controller 4 has a memory block 10 and memory means 11. The access point controller 4 can communicate through other communication equipment 12 with other access point controllers 4 and/or with other communication systems, such as with a public switched telephone network and/or a wireless telecommunication network. Radio communication with the wireless terminal 2 is performed with a radio part 14 arranged in the access point 3. Access point controller 4 is adapted to perform link adaptation, in which a modulation mode is selected using fuzzy control logic stored in memory 11. Link adaptation is executed using the fuzzy control logic in the selection of the modulation mode. Fuzzy control rules are established in which the packet error rate is used, as at least one variable, in the fuzzy logic control.

The wireless communication device 2 of independent claim 16 of this application is illustrated in figure 5a and described at page 15, line 35 through page 16, line 10. The wireless terminal 2 includes a radio (RF) 5 for connecting within communication system 1, via a wireless communication with access point 4 and/or the wireless terminals 2. A control block 6 is used for controlling the operation of the wireless terminal 2. Memory 7 is used in the operation of the wireless terminal 2. Access point controller 4 is adapted to perform link adaptation, in which a modulation mode is selected using fuzzy control logic. Link adaptation is executed using the fuzzy control logic in the selection of the modulation mode. Fuzzy control rules are established in which the packet error rate is used as at least one variable in the fuzzy logic control.

The method, as claimed in this application in independent claim 17, is shown in figure 3b and described at page 13, lines 5 through 27 and at page 15, lines 9-34. The method implements link adaptation in a communication system according to step 307. The invention utilizes a set of fuzzy logic rules to select the modulation mode and/or transmission power for the link according to step 310. The fuzzy logic rules are formulated in such a manner that the packet error rate, calculated at step 308, is used as a variable in the fuzzy logic rules in effecting the selection. Thus, the modulation mode and/or the transmission power control are exercised in accordance with the rules of fuzzy logic using calculated packet error rate.

[6] GROUNDS FOR REJECTION TO BE REVIEWED ON APPEAL

A. The issue presented for review is the propriety of the Examiner's rejection of claims 2-17 under 35 USC 103(a) based on the combined teaching of Agrawal et al, U.S. Patent No.6,072,990   in view of the cited reference, Lewis, U.S. Patent No. 5,687,290, and further in view of disclosure of the cited reference, La Porta, U.S. Patent No. 6,654,359. The rejection is contained in the Office Action mailed July 5, 2006.

[7] Argument

The Examiner has <u>not</u> established that the subject matter claimed in this application is obvious under 35USC103(a) based on the combined teachings of the reference Agrawal, La Porta, and Lewis.

It is well settled that in order to establish a prima facie case for obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, without reference to the disclosure of this application. (MPEP Sec. 2142).

The examiner relies primarily on the disclosure of the cited reference Agrawal to support the rejection based on obviousness. The cited reference Agrawal fails to disclose or suggest the selection of a modulation mode. The cited reference fails to disclose or suggest the use of fuzzy logic in any manner. The cited reference fails to disclose or suggest a fuzzy logic selection process using packet error rate. The cited reference fails to disclose or suggest the transfer of packets comprising a header and a payload.

To reduce system overhead costs, the system of Agrawal controls the frequency of feedback by balancing channel quality against control overhead. To accomplish this, the system of Agrawal monitors <u>word</u> error rate over a window of timeframes to determine an average <u>word</u> error rate. It is only when the average word error rate falls outside the acceptable range that the transmission power is updated (see column 8, lines 3-38). The control parameter, in the system of Agrawal, is defined as a power

code pair, i.e., transmission power and error correction code and these parameters are controlled to determine the correct operating point for current link conditions.

When, in the system of the subject application, modulation mode is selected, the process involves data speed, modulation method, coding rate and other parameters. Significantly different parameters are involved in the system of Agrawal, namely, only transmission power and/or error code. The reference Agrawal, therefore, does not teach the selection of modulation mode.

The Examiner acknowledges that the cited reference Agrawal fails to teach the selection of modulation modes using fuzzy logic and cites the reference Lewis, indicating that it would be obvious to one skilled in the art to adopt fuzzy logic principals, as taught in Lewis, to the system of Agrawal. As motivation for such a combination, the examiner suggests that fuzzy logic would provide a more flexible approach to the selection of the power code pair in Agrawal. Applicant submits that, by virtue of the selection of the power code pair in Agrawal, a more flexible approach is not needed and will be contrary to the stated purpose of Agrawal, namely, <u>to limit the overhead resources needed for the selection process</u>. There is, therefore, nothing in the reference Agrawal to suggest that, the incorporation of the teaching of Lewis within the system of Agrawal would be advantageous and quite the contrary, if anything, Agrawal teaches away from such a combination. The combined teaching of Agrawal and Lewis fails to disclose or imply that fuzzy logic can used to select a modulation mode. Further the combined teaching of Agrawal and Lewis fails to teach the use of packet error rate as a variable in a fuzzy logic rule.

The Examiner further acknowledges that Agrawal does not teach forming packets from the information to be transferred wherein the packets comprise a header and payload.

In response to this deficiency, the Examiner suggests that a person skilled in the art would form such packets based on the cited reference La Porta. Applicant submits that it is well known to form a packet having a header and a payload to include sufficient indentification of the packet to enable routing of the packet from network element to network element and to different networks. It is this structure of a packet that supports Applicants position that word error rate, according to Agrawal, is not the equivalent of packet error rate as used in the subject application. The term "packetization", as used in Agrawal, does not have the significance that the Examiner places on it.

The Examiner has steadfastly clung to the position that the term "word error rate" is the equivalent of "packet error rate". Applicant submits that this assertion is erroneous. It appears that the only definition of "word error rate" in the context of digital transmission is in the reference Agrawal. The Examiner relies on the following sentence at column 1, lines 54-55, as follows:

"Data transmission is usually packetized into words so that the error granularity is at the word level.

However, the Examiner seems to ignore the next sentence which defines "word error rate" in terms of "BER" or bit error rate.

The Examiner has acknowledged the content of articles submitted by Applicant and further states his position as follows:

"The articles talk about bit error rate and how they differ from packet error rate. However, they are silent about word error rate as described in the Agrawal

reference. Packet error rate as described by Applicant and word error rate as described by Agrawal are directed to the same thing, the information units being transmitted through the network. Therefore packet error rate and word error rate would be considered equivalent by a person skilled in the art."

Applicant submits that the definition of the term "word error rate", as used in Agrawal, is not subject to speculation, but is contained in formula (2) at column 1, line 60. Agrawal states:

"Consequently the error rate of interest is the,... (see formula 2 in column 1)... word error rate (WER) as seen at the receiver.

It is significant that Formula 2 is stated in terms of BER. Applicant submits that WER in Agrawal is more or less the equivalent of bit error rate, not packet error rate. Accordingly, the reference Agrawal fails to support the Examiner's position.

In response to Applicant's prior arguments, the Examiner has asserts as follows:

"A network transmits data in the form of packets. Agrawal recites that data is packetized into words (each word is a packet). Packets or words are the units of information being transmitted through the network. If an error rate is calculated on the word units being transmitted through the network, then error is calculated on the packets being transmitted through the network."

Applicant has submitted excerpts from several articles as set forth in Appendix A. The Examiner acknowledges that they discuss bit error rate and how it differs from packet error rate. These articles indicate that "This past work illustrated that the BER is not a good indicator of packet error, nor was packet error a useful indicator of BER." The cited reference Agrawal defines word error rate in terms of bit error rate, yet the Examiner continues to assert that the lack of correlation between bit error rate and packet error rate does not apply to word error rate.

According to the Examiner, words are packetized in Agrawal, therefore the words are the equivalent of bits in Agrawal and therefore, using the Examiner's logic, word error rate is not a good indicator of packet error rate. The Examiner has made a statement that has no technical support and has only responded to Applicant's arguments with his unsupported opinion. The overall significance of this discussion is that a person skilled in the art would not consider word error rate to be the equivalent of packet error rate.

Applicant submits that the above described deficiencies of the primary reference Agrawal are not remedied by the proposed combination with the teaching of the references La Porta and Lewis. The combined teaching of the cited references does not therefore, support a prima-facie case of obviousness. The modification of the teachings of La Porta and Lewis, in order to obtain the invention, as described in the claims submitted herein, would not have been obvious to one skilled in the art.

The above arguments apply equally to independent claims 12, and 15-17 as well as the rejected dependent claims.
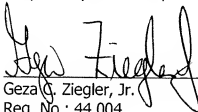
[8] SUMMARY

The combined teaching of the cited references Agrawal, Lewis, and La Porta fails to disclose or imply that fuzzy logic can used to select a modulation mode in link adaptation. Further the combined teaching of Agrawal and Lewis fails to teach the use of packet error rate as a variable in a fuzzy logic rule used in the selection of a modulation mode in link adaptation.

It is respectfully submitted that all of the claims, as presented, are clearly novel and patentable over the prior art of record. Accordingly, the Board of Appeals is respectfully requested to favorably consider the rejected claims and to reverse the final rejections, thereby enabling this application to issue as a U.S. Letters Patent.

The Commissioner is hereby authorized to charge payment for any fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.
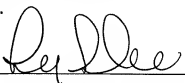
Respectfully submitted,

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Lisa Shimizu
Person Making Deposit

[9]

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CLAIM APPENDIX

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1.(cancelled)

2. (previously presented) The method according to claim 17, wherein in the method a target value is determined to the packet error rate, that the packet error rate is aimed to be kept substantially the same as the target value, and that the difference between the packet error rate and the target value is also used as a variable in the method.

3. (original) The method according to claim 2, wherein for performing fuzzy control a first set of control values is formed, in which the packet error rate is used as a variable, a second set of control values is formed, in which the change rate of the packet error rate is used as a variable, and a set of fuzzy rules is arranged, which are used for determining the effect of the control values to the modulation mode used as a controllable value.

4. (original) The method according to claim 3, wherein said control value sets are formed of the values: positive large, positive medium, positive small, negligible, not small, not medium, and not large.

5. (original) The method according to claim 4, wherein said set of fuzzy rules is determined on the basis of the following table:

PERdt	PER						
	NL	NM	NS	Z	PS	PM	PL
NL	P_6	P_5	P_4	P_3	P_2	P_1	N
NM	P_5	P_4	P_3	P_2	P_1	N	N_1
NS	P_4	P_3	P_2	P_1	N	N_1	N_2
Z	P_3	P_2	P_1	N	N_1	N_2	N_3
PS	P_2	P_1	N	N_1	N_2	N_3	N_4
PM	P_1	N	N_1	N_2	N_3	N_4	N_5
PL	N	N_1	N_2	N_3	N_4	N_5	N_6

6. (original) The method according to claim 5, wherein said first set of control values comprised the following values:

PER	NL	NM	NS	Z	PS	PM	PL
μ=1	0.07	0.08	0.09	0.10	0.11	0.12	0.13

that said second set of control values comprises the following values:

PERdt	NL	NM	NS	Z	PS	PM	PL
μ=1	-0.006	-0.004	-0.002	0	0.002	0.004	0.006

and that said set of fuzzy controls comprises the following values:

N_6	N_5	N_4	N_3	N_2	N_1	N	P_1	P_2	P_3	P_4	P_5	P_6
-1.2	-1.0	-0.8	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8	1.0	1.2

7. (original) The method according to claim 6, wherein in the method a set of modulation modes is defined, wherein for each modulation mode an individualizing index is defined, and in the method at least the following steps are taken:

-    an initialisation phase, wherein one of said indexes is selected in order to select the modulation mode used in the communication connection,

-    a computing phase, in which the difference of the packet error rate from the target value, and the change rate of the packet error rate are calculated, and

-    a fuzzy control phase, in which fuzzy control is used for defining the index change of the modulation mode, wherein the modulation mode according to the calculated new index is selected for the communication connection.

8. (original) The method according to claim 7, wherein said calculating phase and the fuzzy control phase are repeated.

9. (previously presented) The method according to claim 17, wherein the transmission power is also controlled in the method.

10. (original) The method according to claim 9, wherein in the method the modulation mode is adjusted until a such modulation mode is obtained, by which the packet error rate (PER) is substantially the same as said target value of the packet error rate, whereafter the transmission power is adjusted by using fuzzy control.

11. (original) The method according to claim 9, wherein the modulation method and the transmission power are selected substantially simultaneously.

12. (previously presented) A communication system, comprising means for arranging two communication devices to communicate with each other in order to transfer packet-form information at least partly wirelessly, means for determining a packet error rate, and means for selecting a modulation mode for the connection from at least two

modulation modes, wherein the communication system comprises means for using fuzzy control in the selection of the modulation mode, and that at least one variable arranged to be used in fuzzy control is the packet error rate.

13. (original) The communication system according to claim 12, wherein a target value is defined for the packet error rate, that the means for the link adaptation comprise means for adjusting the packet error rate to substantially the same as said target value, and that the difference between the packet error rate and the result value is additionally arranged to be used as a fuzzy control variable.

14. (original) The communication system according to claim 13, wherein for performing fuzzy control a first set of control values is formed, in which the packet error rate has been used as a variable, and a second set of control values, in which the change rate of the packet error rate has been used as a variable, and that a set of fuzzy rules has been formed for defining the influence of the control values of said variables to the modulation mode used as a controllable value.

15. (previously presented) An access point controller comprising means for arranging the access point controller and at least one wireless terminal to communicate with each other in order to transmit packet-form information at least partly in a wireless manner, means for defining the packet error rate, and means for selecting a modulation mode for the connection from at least two modulation modes, wherein the access point controller comprises means for using fuzzy control in the selection of the modulation mode, and that in fuzzy control at least one variable that is arranged to be used is said defined packet error rate.

16. (previously presented) A wireless terminal, comprising means for transmitting packet-form information at least partly wirelessly in a communication connection arranged between the wireless terminal and a second communication device, means for

defining the packet error rate, and means for selecting a modulation mode for the connection from at least two modulation modes, wherein the wireless terminal comprises means for using fuzzy control in the selection of the modulation mode, and that in fuzzy control at least one variable that is arranged to be used is said defined packet error rate.

17.(previously presented) A method for performing link adaptation in a communication system, the method comprising

forming a connection to transfer information at least partly wirelessly between two communication devices;

forming packets from the information to be transferred via the connection, said packets comprising a header and a payload;

determining a packet error rate; and

selecting a modulation mode for the connection from at least two different modulation modes;

wherein said selecting a modulation mode comprises using fuzzy control; and using said packet error rate as one variable for said fuzzy control.

[10]

EVIDENCE APPENDIX

Applicant directs the Boards attention to the following publications that indicate that packet error rate is not the equivalent of WER or BER. Pertinent parts of these articles are abstracted below for the Boards convenience:

Abstract 1. In past work, it is illustrated how bit errors are position independent but have a dependence upon the encoded data [6]. It was found that the errors occur uniformly across any data packet, independent of packet size, and that there are no correlations evident between the positions of errors within the frame. This result is interpreted to be confirming that errors are highly localized within a frame and from this we are able to assume that the error-inducing events occur over small (bit-time) time scales. Further, the work compared BER and packet error rate results, noting that frames containing different data contents lead to substantially different BER performance. Importantly, the relationship between the test data and BER results has little connection with the packet error rates for the same test data. This past work illustrated that the BER is not a good indicator of packet error, nor was packet error a useful indicator of BER (www.cl.cam.ac.uk/~awm22/publication/james2005**packet**.pdf)

Abstract 2. Bit Error Rate (BER) and Packet Error Rate (PER) are important Quality of Service Parameters for Wireless network. Most research in QoS has been devoted to the analysis of BER which gives insight to the mean behavior of the wireless network. However, the mean behavior is not sufficient in a lot of scenarios, and a more precise characterization of the error process is needed. An important example where the mean behavior is not sufficient is PER evaluation. As residual errors at the output of the physical layer are not uniformly distributed, the distribution of these error events is important for deriving PER. Not taking into account this distribution and supposing, for

example, that errors are uniformly distributed, as done in a large proportion of published reports on wireless networking, lead to a gross overestimation of PER that can go to tenfold factors. www-rp.lip6.fr/~khalili/pub/mswim2004.pdf

[11]

RELATED PROCEEDINGS APPENDIX

N/A